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Research Paper

A comparative analysis of value-added forecasts of rainfall in different agroclimatic zones of Assam

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ABSTRACT

The present study is designed to investigate the skillfulness of value addition in the case of forecasted rainfall data in terms of the level of accuracy over the direct model-derived outputs with respective observed rainfall across six agroclimatic zones (ACZs) of Assam during the monsoon season in 2023. The district-wise daily data of three categories viz. model forecast, value-added and actual rainfall provided by India Meteorological Department (IMD) have been compiled ACZ wise and compared. Correlations and regressions were performed to examine the effectiveness of value addition. It was found that the value-added rainfall had higher correlations ($r = 0.52$ and $R^2 = 0.26$) with the actual rainfall compared to model forecast rainfall ($r = 0.42$ and $R^2 = 0.20$) in Assam. Hence, it can be said that the value-added data was more skillful in predicting rainfall compared to model forecast rainfall for the 2023 monsoon season.

Keywords: Value-added rainfall, Agromet Advisory Services, Model forecast rainfall, Correlation and regression

Weather plays an important role in agricultural productivity in a country like India where the agricultural sector has been treated as the backbone of the national economy. Under Gramin Krishi Mausam Sewa (GKMS) scheme, value-added medium range weather forecasts for the next five days are generated by IMD (Singh, 2022; IMD, 2023; IMD, 2024). Based on the forecast, biweekly Agromet Advisory Services (AAS) bulletins are prepared on every Tuesday and Friday (MoES, 2022) and communicated to the farmers to make decisions on day-to-day agricultural operations based on the bulletin provided (IMD, 2024). The value addition of several weather parameters (rainfall, minimum temperature, maximum temperature, morning relative humidity, evening relative humidity, wind speed, wind direction and cloud cover over the direct model-derived outputs (commonly known as without value-added weather parameters) for the agrometeorological services is carried out at respective Regional Meteorological Centres (RMCs) and Meteorological Centres (MCs) for the concerned states based on the regional level weather forecast with the help of high resolution weather forecast model, synoptic knowledge as well as bias correction of district forecast (Chattopadhyay *et al.,* 2016; Chattopadhyay and Chandras, 2018; Sankar *et al.,* 2019; Singh, 2022; IMD, 2024) which is further utilized in preparing the AAS bulletin on bi-weekly basis. Therefore, it is expected to predict a better quality of forecast while utilizing value-added weather parameters compared to model forecast weather parameters in connection with the actual weather data observed at various meteorological observatories of IMD. Singh *et al.,* (2022) validated the value-added forecast data over Punjab during 2013-14 to 2017-18 and found the fruitfulness of value addition in the case of rainfall data. Forecast verification performance was satisfactory over Anand region, Gujarat (Lunagaria *et al.,* 2009) and over south Saurashtra region (Sahu *et al.,* 2011). Kundu *et al.,* (2022) compared global

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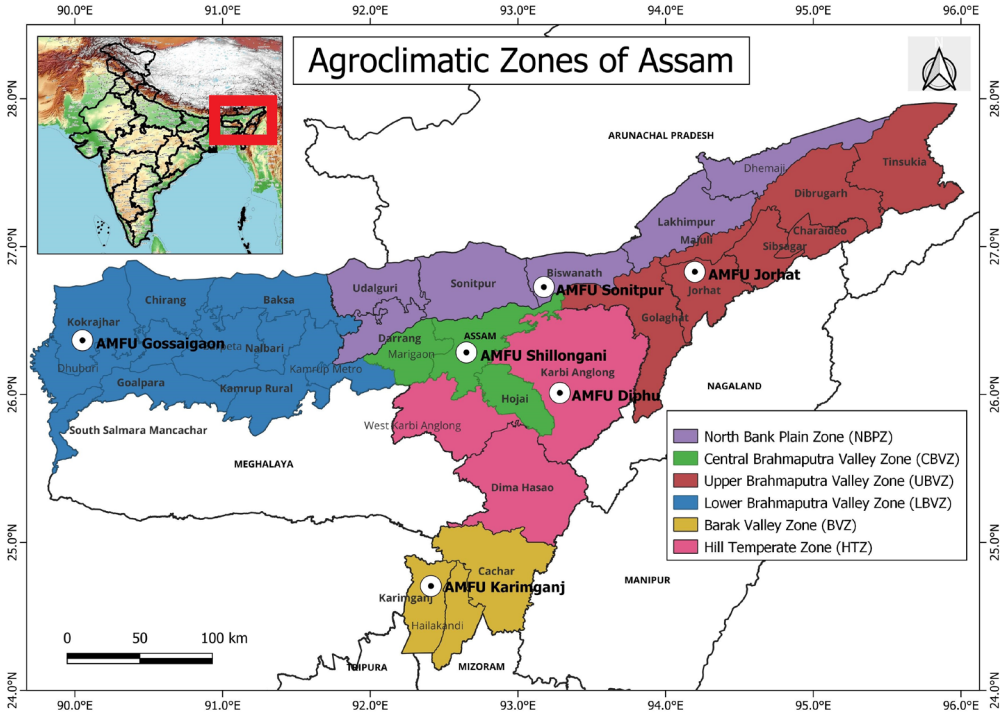

Fig. 1: Location map of agroclimatic zones (ACZ) of Assam

climate models and regional climate models with the IMD rainfall data over the north-west Himalayan region to find out the suitable set of models in order to predict rainfall under various future warming scenarios. The present study analyzed the rainfall pattern incurred from both value-added and model forecast with reference to actual rainfall data to understand the skillfulness of value addition during the monsoon season in 2023 over the Assam.

MATERIALS AND METHODS

The present study was carried out based on the six ACZs of Assam (Fig. 1). The direct model-derived forecast rainfall data was taken from the Agromet Decision Support System (AgroDSS) portal of IMD (weblink: https://agromet.imd.gov.in) for the present investigation. The value addition was carried out over the model forecast based on the local level forecast at Regional Meteorological Centre (RMC) Guwahati. On the other hand, actual/realized data was taken from the rainfall database prepared at RMC Guwahati based on the various meteorological observatories of IMD across Assam.

Methodology

The 122 days of district-wise daily rainfall dataset during the monsoon season ranging from 01st June to 30th September (JJAS) of 2023 from both model forecast and value-added categories were compiled across six ACZs in Assam along with the district-wise actual / realized daily rainfall data for the same period. Regression analysis and correlation analysis was performed in order to examine the statistical relationship between value-added / model forecast rainfall data with actual rainfall. Biases of value-added / model forecast rainfall from actual rainfall are calculated to understand the skill of value addition.

RESULTS AND DISCUSSION

Biases of rainfall

In the case of Lower Brahmaputra Valley Zone (LBVZ), the highest negative bias was found in the case of model forecast (-128.1 mm) on July 04, 2023, while the value is -56.8 mm in the case of value-added forecast (Fig. 2). The actual rainfall received on this day was 18.1 mm over this zone. On the other hand, the highest positive bias was on June 22, 2023 in the case of model forecast (64.2 mm) which is 47.6 mm in the case of value-added forecast compared to actual rainfall. On this day, the average rainfall received in the LBVZ is 90.2 mm. Therefore, the value-added rainfall is predicted closer to the actual rainfall in case of both positive and negative biases on these two days. The biases are also calculated for the rest five ACZs apart from the LBVZ in the state of Assam. It is noted that both positive as well as negative biases are lesser by 5.2 mm and 15.9 mm respectively in case of value-added rainfall compared to model forecast rainfall on an average over Assam.

Correlation and regression

The regression analysis is carried out for all six ACZs so as to investigate the relationship between actual rainfall and value-added forecast as well as actual rainfall and model forecast (Table 1). Though, the value of coefficient of determination (R^2) is low for both – actual versus value-added and actual vs model forecast in the case of LBVZ, however, value-added forecast data indicated higher positive relationship (0.27) compared to model forecast (0.19) with respect to actual rainfall. It implies that value-added rainfall data is more positively related compared to model forecast rainfall data. From the Table 1, it is seen that the R^2 values are always higher in the case of value-added rainfall data compared to model forecast rainfall for all the ACZs.

Table 1: Comparison of mean seasonal rainfall from actual, value-added and model forecast data, and relations (r, R^2) with actual rainfall in different agroclimatic zones during monsoon season in 2023

Agroclimatic zone	Agromet field unit (AMFU) location	Mean rainfall (mm per day)			Coefficient of determination (R^2) with		Correlation coefficient (r) with	
		Actual	Value added	Model forecast	Value added	Model forecast	Value added	Model forecast
Lower Brahmaputra Valley Zone (LBVZ)	Gossaigaon (Kokrajhar)	13.0	25.1	19.5	0.27	0.19	0.52	0.44
Upper Brahmaputra Valley Zone (UBVZ)	Jorhat	8.8	21.1	15.2	0.24	0.14	0.49	0.38
North Bank Plain Zone (NBPZ)	Biswanath Chariali (Biswanath)	11.3	21.1	14.3	0.36	0.27	0.60	0.52
Central Brahmaputra Valley Zone (CBVZ)	Shillongani (Nagaon)	5.9	19.3	15.2	0.06	0.03	0.40	0.17
Barak Valley Zone (BVZ)	Karimganj	12.3	21.0	14.6	0.40	0.34	0.63	0.58
Hill Temperate Zone (HTZ)	Diphu (Karbi Anglong)	4.9	20.5	19.5	0.21	0.20	0.46	0.45
Assam		9.4	21.4	16.4	0.26	0.20	0.52	0.42

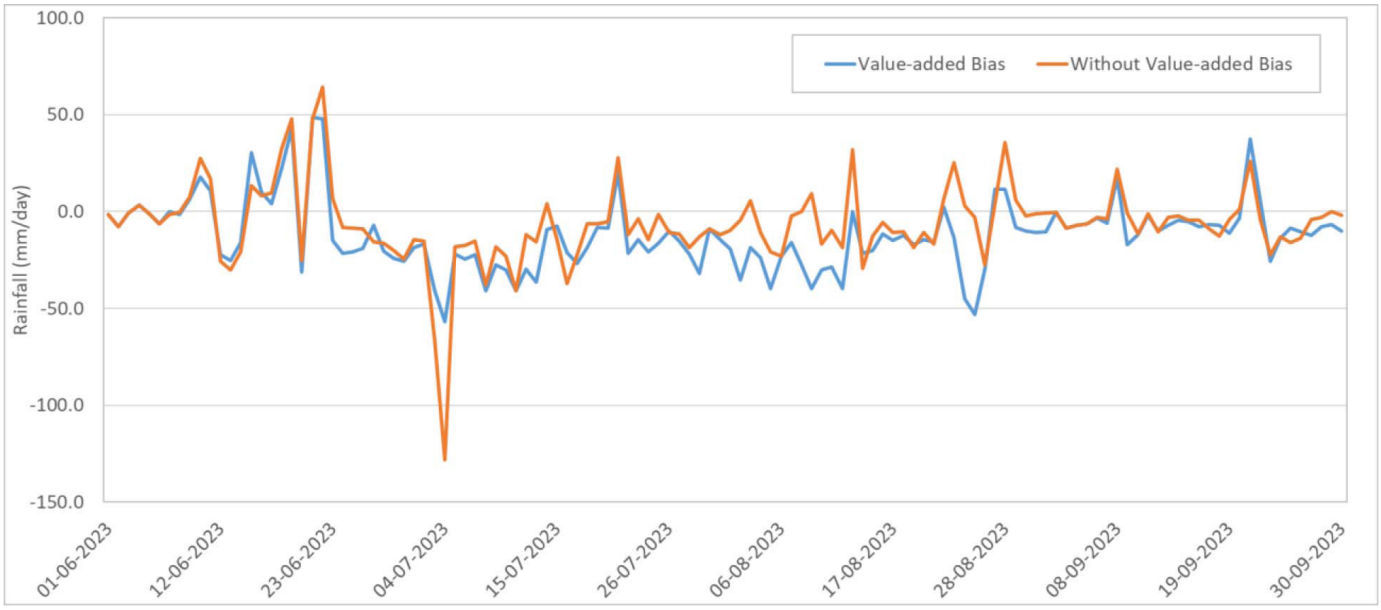

Fig. 2: Daily rainfall biases of value-added rainfall data and model forecast rainfall data from the actual rainfall during 122 days of monsoon season in 2023 for LBVZ.

The highest correlation coefficient (Table 1) between both actual rainfall and value-added rainfall (r = 0.63) as well as actual rainfall and model forecast rainfall (r = 0.58) were found in the case of the BVZ. The correlation was positive and stronger in the case of value-added rainfall compared to model forecast. On the other hand, the lowest correlation was found in CBVZ for both value-added (r = 0.40) and model forecast (r = 0.17), however, the relationship was much weaker in the case of the model forecast rainfall compared to value-added. On an average, the relationship of value-added rainfall (r = 0.52) was statistically stronger than that of model forecast rainfall (r = 0.42) over Assam with respect to actual rainfall (Table 1).

Therefore, it can be said that the value addition over the direct model-derived rainfall is more effective and skillful with respect to actual rainfall in the case of Assam during the monsoon season in 2023. The skillful value addition in terms of accuracy is very crucial in order to prepare AAS bulletins as these value-added weather parameters are considered for the basic inputs of the bulletins disseminated to the farmers.

CONCLUSIONS

The present study emphasized on the effectiveness of the value addition of rainfall data in terms of the level of accuracy over the direct model forecast rainfall data with respect to the actual rainfall data over the Assam region across its six ACZs during the monsoon season in 2023. It is therefore concluded that the value

addition is significantly effective for the forecasting of rainfall in order to provide improved AAS bulletins.

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Data availability: Value-added and Model forecast data is available with the AgroDSS Portal of IMD while realized rainfall data is obtained from the IMD data supply portal at https://dsp.imdpune.gov.in/.

Authors Contribution: **SKK:** Data compilation, Data analysis, Conceptualization, Methodology, Visualization, Presentation, Writing-original draft, Writing-review; **AKVH, SD, DH, GK, SOS, KNM:** Resources.

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